

WHAT IS CLAIMED IS:

1. A method for manufacturing an optical filter comprising:
depositing a material on a substrate;
predicting a deposition stop time during the depositing of the material but prior to reaching the predicted stop time; and
stopping deposition substantially at the predicted stop time.
2. The method of Claim 1, wherein said predicting comprises measuring an optical property of the deposited material at a plurality of times after the start of material deposition, and comparing the measurements to values predicted by a defined functional relationship between said optical property and time of deposition.
3. The method of Claim 2, wherein said defined functional relationship is theoretically valid at substantially all times during film deposition.
4. The method of Claim 2, wherein said functional relationship defines transmittance $f(t)$ as a function of time, and is defined as:
$$f(t) = \frac{1}{a_0 + a_1 \cos(a_2 t + a_3)} + a_4$$
wherein a_0 , a_1 , a_2 , a_3 , and a_4 are constant coefficients.
5. An optical filter manufactured by the method of Claim 1.
6. An improved method of depositing a layer of material having a desired thickness onto a substrate to form an optical filter, wherein the improvement comprises predicting, during the process of depositing the layer but before reaching said desired thickness, a time at which to stop depositing the film by measuring an optical property of the film and utilizing that measurement to determine a time at which said desired thickness will be reached.
7. The method of Claim 6, wherein the optical property is selected from the group consisting of energy transmittance and energy reflectance.
8. The method of Claim 6, wherein the predicting comprises using a theoretical formula for the optical property, the formula having at least one theoretical constant.

9. The method of Claim 8, wherein the formula further comprises at least one compensated constant term.

10. The method of Claim 9, wherein one of said compensated constant terms is dependent on a measuring device that measures the optical property.

11. A method for manufacturing an optical filter where a film is formed on a substrate comprising:

measuring an optical characteristic of the filter at selected points in time by irradiating the film with light;

calculating a theoretical value of the optical characteristic utilizing a theoretical formula comprising at least one empirically adjustable constant parameter;

compensating the at least one empirically adjustable constant parameter to provide an adjusted parameter so that the difference between the theoretical value and the measured value of the optical characteristic are minimal;

predicting the optimal time of forming the film with the adjusted parameter;
and

stopping the forming at the optimal time.

12. The method of Claim 11, wherein the optimal time of forming the film is predicted after the amount of change in the adjusted parameter from one selected time to a later selected time falls within a preset range.

13. The method of Claim 11, wherein at least one adjusted parameter is dependant on a device that measures the optical characteristic.

14. The method of Claim 11, wherein the optical characteristic is selected from the group consisting of energy transmittance and energy reflectance.

15. An improved method of time controlled deposition of a film onto a substrate to form an optical filter, wherein the improvement comprises:

measuring an optical property of the film;

utilizing the measurement to determine a designed thickness achieving time at which the film will be complete;

predicting, while the film is being deposited, a stop signal initiation time at which to initiate a deposition stop signal that stops the deposition of the film;

wherein the stop signal initiation time is dependent on both the designed thickness achieving time and a time delay between the stop signal initiation time and the actual termination of material deposition.

16. The method of Claim 15, wherein the optical property is selected from the group consisting of energy transmittance and energy reflectance.

17. An apparatus for depositing a film on a substrate comprising:
a light source emitting an optical characteristic measuring light;
a timer for measuring time as the film is deposited;
a detector for detecting the measuring light and developing a signal corresponding to the measuring light intensity detected at selected times;

a processor configured (1) to compare the measured signal level to a theoretically expected signal level at said selected times, (2) to determine a stopping time at which the deposition of the film is to be stopped, wherein the stopping time is determined while the deposition occurs and significantly prior to reaching said stopping time, and (3) to stop the deposition substantially at the determined stopping time.

18. A method of manufacturing an optical filter comprising:
depositing a film on a substrate;
measuring the time of the deposition of the film;
measuring transmittance of the filter at regular intervals of time by irradiating the filter;

determining, from the transmittance measurement, the time at which the deposition will be complete using at least in part an equation relating filter transmittance to deposition time having the following functional form:

$$f(t) = \frac{1}{a_0 + a_1 \cos(a_2 t + a_3)} + a_4 \text{ and}$$

stopping the deposition of the film at the determined time.

19. A method of manufacturing an optical filter comprising a plurality of layers of deposited material, said method comprising:

modeling an optical characteristic of said filter with an equation relating said optical characteristic to deposition time, said equation having a functional form that is theoretically valid at substantially all times during film deposition; and

using said model to select a deposition stopping time during film formation.

20. The method of Claim 19 wherein using said model comprises adjusting one or more constant terms in said formula so as to minimize differences between measured values of said optical characteristic and values of said optical characteristic calculated with said equation.